**WHAT IS CLAIMED IS:**

1. A lens for focusing an ultrasound wave having a wavelength, comprising a plurality of substantially concentric rings disposed about a central point, at least one of the rings having a substantially triangular cross-section defined by first, second, and third sections, the first section extending from a proximal end radially away from the central point to a distal end, the second section extending from the distal end of, and substantially perpendicular to, the first section and terminating at a peak, and the third section smoothly sloping from the proximal end of the first section to the peak of the second section, and wherein the first, second and third sections have lengths with respect to the wavelength of the ultrasound wave such that (i) phases of the ultrasound wave are substantially additive at a focal point located on an axis perpendicular to the lens that passes through the central point, and (ii) aggregate focused ultrasound energy would not be predicted at the focal point by Snell's law refraction.

2. The lens of claim 1, wherein the lens is formed substantially from polystyrene.

3. The lens of claim 1, wherein the lens is formed substantially from crystal polystyrene.

4. The lens of claim 1, wherein the third section slopes along a substantially straight trajectory from the proximal end of the first section to the peak of the second section.

5. The lens of claim 4, wherein third sections of respective substantially concentric rings have smaller

lengths as the respective substantially concentric rings are radially further from the central point.

6. The lens of claim 5, wherein the slopes of the respective third sections are larger as the substantially concentric rings are radially further from the central point.

7. The lens of claim 6, wherein first sections of respective substantially concentric rings have smaller lengths as the substantially concentric rings are radially further from the central point.

8. The lens of claim 7, wherein:

the respective first sections of adjacent substantially concentric rings extend radially from the central point such that the distal end of the first section of an inner one of the adjacent substantially concentric rings terminates at the proximal end of the first section of an outer one of the adjacent substantially concentric rings; and

radii, $r_i$, extending from the central point to each of the distal ends of the first sections of the substantially concentric rings, adhere to the following equation:

$$(r_i^2 + F^2)^{1/2} \cong F + \lambda_f \cdot i,$$

where i = 1, 2, 3,…, F is a distance from a plane defined by the peaks of the substantially concentric rings to a focal point as measured along an axis normal to the plane, and $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens.

9. The lens of claim 1, wherein the lengths of first sections of respective ones of the substantially concentric rings are less than about five wavelengths of the ultrasound wave.

10. The lens of claim 1, wherein the third section slopes along a curved trajectory from the proximal end of the first section to the peak of the second section.

11. The lens of claim 10, wherein:

respective first sections of adjacent substantially concentric rings extend along a radius, r, from the central point such that the distal end of the first section of an inner one of the adjacent substantially concentric rings terminates at the proximal end of the first section of an outer one of the adjacent substantially concentric rings; and

third sections of respective substantially concentric rings are curved to substantially match respective segments of the following function of r:

$$(1/\lambda_f) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (1/\lambda_f - 1/\lambda_{lens})^{-1},$$

where $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens, and F is a distance from a plane defined by the peaks of the substantially concentric rings to a focal point measured along an axis normal to the plane.

12. The lens of claim 1, wherein second sections of respective concentric rings have substantially equal lengths.

13. The lens of claim 12, wherein the lengths of the of the respective second sections are proportional to:

$$(1/\lambda_f) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (1/\lambda_f - 1/\lambda_{lens})^{-1},$$

where $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens, $\lambda_{lens}$ is the wavelength of the ultrasound wave in the lens, and r is the radius from the center point to the distal end of the first section of one of the substantially concentric rings.

14. The lens of claim 13, wherein the lens includes a base having spaced apart first and second surfaces such that the base has a substantially uniform thickness between the first and second surfaces, and the substantially concentric rings are disposed on the first surface of the base such that the second sections of the respective substantially concentric rings extend from the first surface of the base away from the second surface of the base.

15. A lens for focusing an ultrasound wave, comprising:

a base having spaced apart first and second surfaces and a central axis extending between the first and second surfaces; and

a plurality of substantially concentric rings disposed about the central axis and defining respective contours of the first and second surfaces of the base, the substantially concentric rings being sized and shaped such that, in cross-section, a plurality of concentric radially extending zones are defined from the central axis toward a periphery of the base, at least some of the rings having a substantially triangular cross-section such that a thickness of the base from the first surface to the second surface substantially smoothly increases with increased radial distance from the central axis within at least a portion of a given zone,

wherein the respective substantially concentric rings are sized and shaped such that (i) phases of the ultrasound wave are substantially additive at a focal point located on the central axis perpendicular to the lens, and (ii) aggregate focused ultrasound energy would not be predicted at the focal point by Snell's law refraction.

16. The lens of claim 15, wherein the rings having a substantially triangular cross-section are defined by first, second, and third sections, the first section extending from a proximal end radially away from the central axis to a distal end, the second section extending from the distal end of, and substantially perpendicular to, the first section and terminating at a peak, and the third section sloping from a point substantially at the proximal end of the first section to the peak of the second section.

17. The lens of claim 16, wherein each radially extending zone includes at most one ring from each of the first and second surfaces of the base.

18. The lens of claim 17, wherein each radially extending zone includes only one ring from one of the first and second surfaces of the base.

19. The lens of claim 18, wherein adjacent radially extending zones include rings from respective ones of the first and second surfaces of the base.

20. The lens of claim 17, wherein each radially extending zone includes one ring from each of the first and second surfaces of the base.

21. The lens of claim 20, wherein the respective contours of the first and second surfaces in each radially extending zone appear as mirror images of one another.

22. The lens of claim 16, wherein the third section slopes along a substantially straight trajectory from the proximal end of the first section to the peak of the second section.

23. The lens of claim 17, wherein third sections of respective substantially concentric rings have smaller lengths as the respective substantially concentric rings are radially further from the central axis.

24. The lens of claim 23, wherein the slopes of the respective third sections are larger as the substantially concentric rings are radially further from the central point.

25. The lens of claim 24, wherein first sections of respective substantially concentric rings have smaller lengths as the substantially concentric rings are radially further from the central axis.

26. The lens of claim 25, wherein:

the respective first sections of adjacent substantially concentric rings extend radially from the central axis such that the distal end of the first section of an inner one of the adjacent substantially concentric rings terminates at the proximal end of the first section of an outer one of the adjacent substantially concentric rings; and

radii, $r_i$, extending from the central axis to each of the distal ends of the first sections of the substantially concentric rings, adhere to the following equation:

$$(r_i^2 + F^2)^{1/2} \cong F + \lambda_f \cdot i,$$

where $i = 1, 2, 3, \ldots$, F is a distance from a plane defined by the peaks of the substantially concentric rings to a focal point as measured along the central axis of the lens, and $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens.

27. The lens of claim 16, wherein the lengths of the first sections of respective ones of the substantially concentric rings are less than about five wavelengths of the ultrasound wave.

28. The lens of claim 16, wherein the third section slopes along a curved trajectory from the proximal end of the first section to the peak of the second section.

29. The lens of claim 28, wherein:

respective first sections of adjacent substantially concentric rings extend along a radius, r, from the central point such that the distal end of the first section of an inner one of the adjacent substantially concentric rings terminates at the proximal end of the first section of an outer one of the adjacent substantially concentric rings; and

third sections of respective substantially concentric rings are curved to substantially match respective segments of the following function of r:

$({}^{1}/\lambda_f) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (1/\lambda_f - 1/\lambda_{lens})^{-1}$, where $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens, and F is a distance from a plane defined by the peaks of the substantially concentric rings to a focal point measured along the central axis of the lens.

30. The lens of claim 16, wherein second sections of respective concentric rings have substantially equal lengths.

31. The lens of claim 30, wherein the lengths of the of the respective second sections are proportional to:

$$(1/\lambda_f) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (1/\lambda_f - 1/\lambda_{lens})^{-1},$$

where $\lambda_f$ is the wavelength of the ultrasound wave in a medium outside the lens, $\lambda_{lens}$ is the wavelength of the ultrasound wave in the lens, and r is the radius from the center point to the distal end of the first section of one of the substantially concentric rings.

32. The lens of claim 15, wherein the lens is formed substantially from polystyrene.

33. The lens of claim 15, wherein the lens is formed substantially from crystal polystyrene.

34. An ultrasound wave unit, comprising:

a flat ultrasound planar member including an array of piezoelectric transducers disposed between spaced apart forward and rearward surfaces, and being operable to produce an ultrasound wave propagating from the forward surface in a direction substantially perpendicular thereto; and

a flat lens sonically communicating with the forward surface of the ultrasound planar member for focusing the ultrasound wave.

35. The ultrasound wave unit of claim 34, wherein: the lens includes

a plurality of substantially concentric rings disposed about a central point on the first surface of the base,

each ring has a substantially triangular cross-section defined by first, second, and third sections, the first section extending from a proximal end radially away from the central point to a distal end, the second section extending from the distal end of, and substantially perpendicular to, the first section and terminating at a peak, and the third section sloping from the proximal end of the first section to the peak of the second section, and

the first, second, and third sections of each ring have respective lengths such that phases of the ultrasound wave are substantially additive at a focal point located away from the lens along an axis perpendicular to the lens and passing through the center point when the ultrasound wave propagates through the lens in a direction perpendicular to the first section.

36. The ultrasound wave unit of claim 35, wherein:

the respective first sections of adjacent substantially concentric rings extend radially from the central point such that the distal end of the first section of an inner one of the adjacent substantially concentric rings terminates at the proximal end of the first section of an outer one of the adjacent substantially concentric rings; and

radii, $r_i$, extending from the central point to each of the distal ends of the first sections of the substantially concentric rings, adhere to the following equation:

$$(r_i^2 + F^2)^{1/2} \cong F + \lambda_f \cdot i,$$

where $i = 1, 2, 3, \ldots$, $F$ is a distance from a plane defined by the peaks of the substantially concentric rings to the focal point as measured along an axis normal to the plane, and $\lambda_f$ is a wavelength of the ultrasound wave in a medium outside the lens.

37. The ultrasound wave unit of claim 36, wherein second sections of respective concentric rings have substantially equal lengths.

38. The ultrasound wave unit of claim 37, wherein the lengths of the of the respective second sections are proportional to:

$$(1/\lambda_f) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (1/\lambda_f - 1/\lambda_{lens})^{-1},$$

where $\lambda_{lens}$ is a wavelength of the ultrasound wave in the lens, and r is the radius from the center point to the distal end of the first section of one of the substantially concentric rings.

39. The ultrasound wave unit of claim 38, wherein each of the third sections slope along a substantially straight trajectory from the proximal end of the respective first section to the peak of the respective second section.

40. The ultrasound wave unit of claim 35, further comprising a flexible bag sonically communicating with the lens and defining an inner volume containing a fluid having an acoustic impedance substantially similar to that of human tissue.

41. The ultrasound wave unit of claim 34, wherein the piezoelectric transducers are formed from ceramic material.

42. The ultrasound wave unit of claim 34, wherein the piezoelectric transducers are formed from polyvinylidene difluoride material.

43. The ultrasound wave unit of claim 34, wherein the ultrasound planar member includes:

an array of signal electrodes disposed on a layer of piezoelectric material such that each signal electrode covers respective areas of the piezoelectric material; and

a respective signal run extending from each signal electrode toward a periphery of the piezoelectric material in a routing direction, subsets of the signal electrodes being disposed in a direction corresponding to the routing direction of the respective signal runs of the signal electrodes of a given subset.

44. The ultrasound wave unit of claim 43, wherein each signal electrode of a given subset includes a length and a width defining its area of coverage and an aspect ratio, the aspect ratios of adjacent signal electrodes of the subset varying in accordance with their respective positions along the routing direction.

45. The ultrasound wave unit of claim 44, wherein the aspect ratios of adjacent signal electrodes of the subset increases in the routing direction when the respective lengths of the signal electrodes of the subset are oriented in the routing direction and the aspect ratios are defined by the quotients of the lengths to the widths of the signal electrodes.

46. The ultrasound wave unit of claim 45, wherein the respective widths of adjacent signal electrodes in the routing direction decrease such that the signal runs from other signal electrodes of the subset may be routed in the routing direction toward the periphery of the piezoelectric material.

47. The ultrasound wave unit of claim 46, wherein the line of signal electrodes in the subset has first and second sides extending in the routing direction and at least one signal run is routed along each of the first and second sides.

48. The ultrasound wave unit of claim 47, wherein signal runs of adjacent signal electrodes are routed along opposite ones of the first and second sides.

49. The ultrasound wave unit of claim 47, wherein at least two signal runs of adjacent signal electrodes are routed along a same one of the first and second sides.

50. The ultrasound wave unit of claim 46, wherein the line of signal electrodes in the subset have first and second sides extending in the routing direction and all of the signal runs are routed along a same one of the first and second sides.

51. A replaceable ultrasound wave unit, comprising:

an ultrasound planar member including an array of piezoelectric transducers disposed between spaced apart forward and rearward surfaces, the ultrasound planar member being operable to produce an ultrasound wave propagating from the forward surface in a direction substantially perpendicular thereto;

a plurality of terminals that are electrically connected to respective ones of the piezoelectric transducers; and

a fluid box thermally communicating with the rearward surface of the ultrasound planar member and including at least one input/output fluid port for entry and egress of cooling fluid.

52. The replaceable ultrasound wave unit of claim 51, wherein the plurality of terminals are rearwardly directed and disposed about a periphery of the ultrasound planar member.

53. The replaceable ultrasound wave unit of claim 51, wherein the at least one input/output fluid port is rearwardly and substantially perpendicularly directed with

respect to the rearward surface of the ultrasound planar member.

54. The replaceable ultrasound wave unit of claim 51, wherein the ultrasound planar member includes a substantially four-sided periphery and at least some of the plurality of rearwardly directed terminals are disposed at each side of the four-sided periphery.

55. The replaceable ultrasound wave unit of claim 51, wherein the array of piezoelectric transducers is formed from at least one of multi-layer piezoelectric polymeric transducers and piezoelectric ceramic transducers.

56. The replaceable ultrasound wave unit of claim 51, further comprising at least one memory device containing information concerning properties of the array of piezoelectric transducers, the at least one memory device being machine readable by way of at least one of the rearwardly directed terminals.

57. The replaceable ultrasound wave unit of claim 51, further comprising a flexible bag sonically communicating with the forward surface of the ultrasound planar member and defining an inner volume containing at least de-gased water.

58. The replaceable ultrasound wave unit of claim 51, further comprising cooling fluid disposed in the fluid box, the cooling fluid being at least one of liquid and gas.

59. The replaceable ultrasound wave unit of claim 58, wherein the cooling fluid is at least partially water.

60. The replaceable ultrasound wave unit of claim 59, wherein the cooling fluid is at least partially air.

61. The replaceable ultrasound wave unit of claim 51, wherein the fluid box is sized and shaped to substantially overlie the rearward surface of the ultrasound planar member.

62. The replaceable ultrasound wave unit of claim 61, wherein the ultrasound planar member includes a backing layer define at least a part of the rearward surface of the planar member and the fluid box has a cap-shape positioned with respect to the backing layer to define a volume for receiving the cooling fluid.

63. The replaceable ultrasound wave unit of claim 62, wherein the backing layer is formed substantially from one of alumina and silicon carbide.

64. The replaceable ultrasound wave unit of claim 62, wherein the fluid box includes first and second spaced apart input/output fluid ports communicating with the volume.

65. The replaceable ultrasound wave unit of claim 64, wherein the cap includes a substantially planar inner surface spaced away from the backing layer and at least one transversely directed fin extending from the inner surface and towards the backing layer to channel the cooling fluid over the backing layer.

66. The replaceable ultrasound wave unit of claim 65, wherein the cap includes a plurality of transversely directed fins extending from the inner surface, some of the fins substantially reaching the backing layer and others of

the fins terminating substantially away from the backing layer such that the cooling fluid: (i) enters the volume through the first input/output fluid port; (ii) is directed away from the second input/output fluid port; (iii) is directed over the backing layer past the second input/output fluid port; and (iv) is directed toward and out of the second input/output fluid port.

67. The replaceable ultrasound wave unit of claim 64 wherein the cooling fluid is urged into and out of the input/output fluid ports using suction.

68. A lens for focusing an ultrasound wave, the lens comprising a body formed from a material having acoustic velocity $v_l$ , the body having an axis, front and rear surfaces transverse to the axis, and radial directions perpendicular to the axis, said body varying in thickness in the radial directions so as to define a plurality of rings concentric with the axis on at least one of the surfaces, each ring having an outer wall substantially parallel to the axis and a smoothly sloping active wall extending radially and axially so that the thickness of the lens varies progressively in the radial direction within each ring, the progressively varying thickness of the lens within the rings and the shape of the active surfaces being selected such that (i) when the lens is disposed in a medium having an acoustic velocity $v_m$ different from $v_l$ and an ultrasonic wave having a wavelength $\lambda_m$ in the medium and having uniform phase in a plane perpendicular to the axis is incident on one of the surfaces of the lens, portions of the ultrasonic wave passing through the active surfaces of the rings will be substantially in phase with one another at a focal point on the axis, and (ii) the ultrasonic wave would not be focused

at the focal point based on application of Snell's law of refraction to the active wall surfaces.

69. A lens for focusing an ultrasound wave, the lens comprising a body formed from a material having acoustic velocity $v_l$ , the body having an axis, front and rear surfaces transverse to the axis, the body varying in thickness so as to define a plurality of raised portions on at least one of the surfaces, each such raised portion having an active wall extending transverse to the axis and sloping smoothly in an axial direction parallel to the axis so that the thickness of the lens varies progressively in at least one direction transverse to the axis within each raised portion, the thickness of the lens within the raised portions being selected so that when the lens is disposed in a medium having an acoustic velocity $v_m$ different from $v_l$ and an ultrasonic wave having a wavelength $\lambda_m$ in the medium and having uniform phase in a plane perpendicular to the axis is incident on one of the surfaces of the lens such that (i) when the lens is disposed in a medium having an acoustic velocity $v_m$ different from $v_l$ and an ultrasonic wave having a wavelength $\lambda_m$ in the medium and having uniform phase in a plane perpendicular to the axis, portions of the ultrasonic wave passing through the active surfaces of the raised portions will be substantially in phase with one another at at least one focal point on the axis, and (ii) the ultrasonic wave would not be focused at the focal point based on application of Snell's law of refraction to the active wall surfaces.

70. A lens for focusing an ultrasound wave having a frequency f and a wavelength $\lambda_m$ in a medium having an acoustic velocity $v_m$ , the lens comprising a body formed from a material having acoustic velocity $v_l$ different from $v_m$, the

body having an axis, front and rear surfaces transverse to the axis, and radial directions $r_i$ perpendicular to the axis, the body varying in thickness in the radial directions so as to define a plurality of rings concentric with the axis on at least one of the surfaces, each ring having an outer wall substantially parallel to the axis and a smoothly sloping active wall extending radially and axially so that the thickness of the lens varies progressively in the radial direction within each ring substantially according to the formula:

$$(f/V_m) \cdot ((r_1^2 + F^2)^{1/2} - F) \cdot (f/V_m - f/V_1)^{-1},$$

where F is a distance from the axis to a focal point located along the axis away from the lens.

71. A lens as claimed in claim 70 wherein all of the active surfaces are disposed on the rear surface of the lens.

72. A lens as claimed in claim 70 wherein the body is substantially planar and extends in a plane perpendicular to the axis.

73. A lens as claimed in claim 70 wherein the active surfaces are substantially conical and the thickness of the lens varies with radius according to a linear approximation of the formula.

74. A lens as claimed in claim 73 wherein the linear approximation is selected so that the thickness of the lens at the innermost and outermost edges of each active surface is equal to the thickness according to the formula.